

Original Research Article

Comparison of fentanyl versus fentanyl plus magnesium as post-operative epidural analgesia in orthopedic hip surgeries

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Abstract

Introduction: Post-operative pain is often inadequately treated. Optimal utilization of the available resources is essential for improving pain management. Magnesium has antinociceptive effects in animal and human models of pain.

Materials and methods: 60 patients of either sex, belonging to 45-60 years of age, ASA grade I and II admitted for orthopedic hip surgeries. In the post-operative period when patient first complained of pain, they received either 50 mcg of Fentanyl (GROUP-F) or 50 mcg of Fentanyl plus 50 mg of Magnesium (GROUP-FM) diluted to 6 ml with normal saline. The parameters monitored were duration of analgesia, quality of analgesia (vas and vrs), cardio-respiratory effects: pulse rate, blood pressure (sbp and dbp), and respiratory rate and side effects like: nausea, vomiting, hypotension, sedation, respiratory depression.

Results: Mean onset of analgesia in Group F was 16.2 ± 2.67 min and in Group FM was 15.9 ± 3.4 min. The duration of analgesia in Group F was 160 ± 18.19 min and in Group FM was 337.3 ± 47.48 min. In our study, there is mild fall in pulse rate and diastolic BP with both groups, more so with Fentanyl plus Magnesium group, and respiratory parameters were stable in both groups. In our study 50 mg of epidural Magnesium coadministered with Fentanyl in Group FM resulted in lower VAS scores at 2,3,4 hours postoperatively.

Conclusion: Epidural Magnesium (50 mg) as an adjuvant to epidural Fentanyl (50 mcg) for postoperative analgesia resulted in prolonged duration of analgesia when compared to epidural Fentanyl (50 mcg) alone.

Key words

Fentanyl, Magnesium, Epidural Analgesia.

Introduction

Good postoperative pain control is an important part of adequate postoperative care. However, 30–80% of postoperative patients complain about moderate to severe post-surgical pain [1]. Inadequate postoperative pain relief may delay recovery, lead to a prolonged hospital stay, patient anxiety, stress and increase medical costs [3]. Inadequately treated pain can lead to detrimental physiological effects and may also have psychological, economic and social adverse effects [2].

Post-operative pain is a self-limiting phenomenon, most intense during the first 24 hours and diminishes during the next 24 hours. Pain is minimal after 3-4 days following surgery. Post-operative pain is often associated with increased incidence of other unpleasant symptoms like nausea, vomiting, sweating and can be a cause of post-operative hemodynamic alterations.

Effective pain control is essential for optimal care of surgical patients; especially in patients undergoing orthopedic surgeries as these patients suffer from considerable pain in the postoperative period. Despite advances in knowledge of pathophysiology of pain, pharmacology of analgesics and development of effective techniques for post-operative pain control, many patients continue to experience considerable discomfort. Management of post op pain has been done in two phases, one is preventive aspect and the other is the actual treatment of the pain.

The preventive phase can play a significant role by preoperatively preparing the patient psychologically by explaining the surgical procedure and the probable intensity of pain.

Pharmacological preparation by adequate premedication and by observance of accepted

surgical principles and good anesthesia coupled with proper post-operative care to minimize the amount of postoperative pain [3].

The following general methods of controlling post-operative pain are being used [4].

- Drug treatment of post-operative pain: narcotics and non-narcotic analgesics, sedatives and antispasmodics.
- Regional techniques: Inter costal blocks, thoracic para vertebral block, caudal block in children (sacra epidural), Continuous caudal block in adult, Continuous brachial plexus block,

Epidural blockade is becoming one of the most useful & versatile procedures of current day anesthetic practice. Unique in that it can be placed at virtually any level of the spine, allowing more flexibility in its application is more versatile than spinal anesthesia, as it can provide anesthesia and analgesia, as well as treatment of chronic disease syndromes [5].

Epidural analgesia is a safe technique for post-operative pain relief and equivalent to traditional analgesic methods. Epidural narcotics have been extensively used for post-operative analgesia. However, disadvantage with use of traditional drugs like morphine is that many side effects such as nausea, vomiting, pruritis; urinary retention, drug dependence and delayed respiratory depression have been reported. They cannot be used in elderly patients. Epidural opioids are proven to be very effective for postoperative analgesia. Because of its greater lipophilic nature, Fentanyl offers some advantages for Epidural analgesia. The rapidity of analgesic effect of Epidural Fentanyl administration and the relatively short duration of action makes it the drug of choice for postoperative acute pain [6].

Magnesium, the non-competitive NMDA antagonist, administered intrathecally, is proved to prolong the duration of spinal opioid analgesia in humans. Co-administration of Epidural Magnesium sulphate for postoperative Epidural analgesia has provided a pronounced reduction in patient controlled Epidural Fentanyl consumption without any side effects.

Our aim of study was to compare and study analgesic property of epidural fentanyl versus fentanyl plus magnesium.

Materials and methods

This study was carried out in the Department of Anesthesiology, Osmania Medical College, Hospital, and Hyderabad from Aug 2011 to Mar 2013. Total number of 30 patients in each group with inclusion and exclusion criteria were selected for study, during a period of 18 months. Patients were allocated randomly to each group.

Inclusion criteria: Patients undergoing Orthopedic lower limb surgeries in the age group of 45-60 years of both sexes of ASA grade I and grade II.

Exclusion criteria: Patients with ASA grade III, IV and V, Patient refusal, Infection at site of injection, Coagulopathy or on anticoagulation, congenital abnormalities of lower spine and meninges, Active disease of CNS, History of allergy to local anesthetics, Patients not willing for participation in the study.

During preoperative visit patient's detailed history, general physical examination and systemic examination was carried out. Basic demographic characters like age, sex were recorded.

During the pre-anesthetic checkup, verbal response score (VRS) and linear visual analogue score (LVAS) was explained to all patients using a 10 centimeter scale and written informed consent was taken from the patient.

Procedure

All the patients were preloaded with 10 ml / kg infusion of Ringer Lactate solution.

All patients were administered combined spinal epidural anesthesia using 2 segment technique after recording baseline pulse, BP and respiratory rate.

An 18G epidural catheter was introduced in L3-L4 space and subarachnoid block was given in L4-L5 space using 3 to 3.5 ml of 0.5% heavy bupivacaine.

Level of sensory block and hemodynamic parameters were monitored intraoperatively.

All surgeries were performed under spinal anesthesia.

No narcotics were administered through out intra operative period.

In the post-operative period, at Visual Analogue Score (VAS) of > 4 , VRS <2 patients were administered 50 mcg of fentanyl diluted to 6 ml with normal saline, in one group (GROUP-F) and 50 mg of Magnesium diluted to 6 ml with normal saline, in another group (GROUP-FM) through epidural catheter. Both the drugs used in the study for epidural injection are preservative free.

Linear Visual Analog Scale Score (VAS)

- 0 – 2 No pain to slight pain
- 3 – 4 Mild pain.
- 5 – 7 Moderate pain.
- 8 – 9 Severe pain.
- 10 Worst possible pain.

Verbal Response Score or pain relief

- 0 no pain relief
- 1 poor pain relief
- 2 fair pain relief
- 3 good pain relief
- 4 excellent pain relief

After giving first dose of epidural Fentanyl or Fentanyl plus Magnesium following variables

were assessed as onset of analgesia, duration of analgesia, quality of analgesia, level of consciousness, cardio-respiratory effects, side effects (if any) all the observations and particulars of each patient were recorded.

The Statistical software namely SPSS 18, were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables. Results on continuous measurements are presented on Mean \pm SD (Min-Max). Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) has been used to find the significance of duration of analgesia, onset of analgesia and VAS & VRS scores between two groups.

Results

60 adult patients belonging to ASA grade I and II, of either sex, in age group between 45- 60 years, posted for elective orthopedic hip surgeries, were selected for the study. They were

randomly allocated to two groups with 30 patients in each group.

There was no significant difference ($p=1.000$) in the sex distribution as samples were gender matched in both groups.

Onset of action was not significantly different in two groups GROUP-F and GROUP-FM and duration of analgesia in GROUP-F ranged from 160 minutes with a mean of ± 18.19 (S.D) minutes and GROUP-FM ranged from 337.3 minutes with a mean of ± 47.48 (S.D) minutes. Statistical analysis showed that duration of analgesia was significantly less in GROUP-F and statistically strongly significant ($p<0.001$).

In our study, majority of the side effects were nausea, vomiting and sedation. In GROUP-F three patients complained of vomiting. In GROUP-FM two patients complained of vomiting. None of the patients had complains of pruritis, urinary retention, respiratory depression (**Table – 1**).

Table - 1: Demographic data.

VARIABLE	GROUP-F	GROUP-FM
Age distribution		
45-50	12	10
50-55	10	12
55-60	8	8
Sex distribution		
Male	24	24
Female	6	6
Onset of action	16 mins	16 mins
Duration of action	160 minutes	337.3 mins
	mean of ± 18.19 (S.D)	± 47.48 (S.D)
Side effects		
Vomiting	3	2
Pruritis	0	0
Urinary retention	0	0

Table – 2 showed that PR in GROUP-F is higher compared to GROUP-FM. The difference in pulse rate was not statistically significant in both groups.

Systolic blood pressure is comparable between the two groups, and was not statistically significant. DBP variation was not statistically significant in both the groups.

From the above table it can be noted that the difference in respiratory rate was not statistically significant ($p>0.05$) in both the groups.

slightly on the higher side (mild pain) for up to 6-8 hrs.

Table – 3 showed that VAS scores in GROUP-F were lower (minimal to mild pain) for up to 3-4 hrs followed by gradual increase which is statistically significant ($p<.01$) when compared to GROUP-FM which showed VAS scores

VRS in GROUP-F had moderate to excellent pain relief up to 3-4 hrs, whereas in GROUP-FM patients had mild to moderate pain relief which was sustained for up to 6-8 hrs, which was statistically significant ($p<0.01$).

Table - 2: Hemodynamic parameters in study.

Pulse rate	0 HR	½ HR	1 HR	2 HR	4 HR	6HR	8 HR
Group-F	84.1±13.4	84.16±14.25	83.8±13.99	84.76±14.12	84.64±14.16	84.36±14.15	83.0±12.43
Group-FM	81.44±12.07	81.40±11.56	80.04±10.66	80.60±9.1	79.64±9.05	79.48±8.19	78.76±9.03
P value	0.455	0.456	0.285	0.222	0.143	0.142	0.174
SYSTOLIC BLOOD PRESSURE							
Group-F	118.4±6.5	118.9±7.0	114.2±6.6	114.7±6.2	117.1±7.7	117.7±5.8	118.9±6.6
Group-FM	117.8±6.3	113.6±6.2	112.2±5.9	113±6.07	116.3±5.9	114.5±6.4	117.7±5.3
P value	0.691	0.159	0.195	0.295	0.605	0.828	0.564
DIASTOLIC BLOOD PRESSURE							
Group-F	80.8±5.6	78.6±6.5	76.5±5.1	77.3±5.8	78.2±5.6	80.1±6.1	80.4±5.9
Group-FM	79.5±8.6	73.8±6	72.7±6.8	73±7.1	75.9±6.8	77.6±6.3	78.2±6.0
P value	0.104	0.407	0.816	0.010	0.153	0.074	0.132
RESPIRATORY RATE							
Group-F	15.1±1.12	14.6±1.03	13.8±1.3	13.8±1.42	14.8±.99	15.9±1.03	16.7±1.07
Group-FM	15.07±1.11	14.7±1.02	14±1.31	13.87±1.3	14.7±1.02	15.9±0.96	17.3±0.99
P value	0.17	0.01	0.09	0.53	0.09	0.27	0.13

Table - 3: Visual Analog Score (VAS).

VAS	0 HR	½ HR	1 HR	2 HR	4 HR	6HR	8 HR
GROUP-F	3.97±.32	2.13±.43	1.46±.50	1.4±.56	2.16±.64	3.2±.49	4.53±.50
GROUP-FM	0.43±0.5	1.9±0.30	2±0.1	2±0.1	2.1±0.3	2.5±0.57	2.86±0.4
P VALUE	0.326	0.008	0.008	0.092	0.025	2066	0.046
Verbal Response Score (VAS)							
GROUP-F		1.4±0.6	2.9±0.1	3.37±0.57	2.83±.64	1.13±.34	0.13±.35
GROUP-FM		1.3±0.7	3.13±.35	3.37±.49.	3.17±.46	2.47±.51	.77±.62
P VALUE		0.411	0.08	0.149	0.025	2.41	1.5

Discussion

Acute post-operative pain is a complex physiologic reaction to tissue injury. Pain is unpleasant sensory emotional experience associated with actual or potential tissue damage. There are two components of pain; physiological and pathological. Post-operative pain is due to direct trauma to the tissue caused by surgery but may be aggravated by associated reflex muscle spasm or visceral distension. Pain being a subjective experience, it is difficult to convey or assess the severity. However in clinical practice two basic approaches in forms of subjective assessment by patients and objective assessment of parameters altered in presence of pain like cardiovascular changes and respiratory changes in response to pain are studied to judge the severity of pain.

Management of post-operative pain still poses a challenge to anesthesiologists in spite of advances in anesthesia and analgesia. Presence of pain indicates presence of some disease or damage in the body. Cutting, tearing, stretching and burning of tissues during surgery produces intraoperative and post-operative pain. Pain is maximum with orthopedic surgery. If this surgical pain is not treated adequately, it may lead to derangement in various body functions. So treating pain is necessary to reduce the post-operative morbidity and mortality. Combined spinal-epidural (CSE) anesthesia is commonly used in orthopedic surgery. It combines both the rapid onset of the spinal analgesia and the flexibility of the epidural catheter.

Opioids are powerful, centrally acting agents which have peripheral effects also, so opioids have been administered for many years to allay anxiety and to reduce pain associated with surgery.

In our study, a total of 60 patients in the age group 45-60 years were, divided randomly into two groups (n=30). There were no differences between two groups with regard to demographic profile. Mean age in group-F (receiving epidural

Fentanyl) was 43.97 ± 13.1 and in group-FM (receiving epidural Fentanyl plus Magnesium) was 44.73 ± 11.9 . Sex ratio was also comparable, in both group-F and group-FM 80% were males and 20% were females. There was significant prolongation of duration of analgesia in GROUP-FM compared to GROUP-F with p 0.001. Out of 30 patients the maximum duration of analgesia in GROUP-FM was 337.3 ± 47.48 , whereas maximum duration of analgesia in GROUP-F was 160 ± 18.19 min.. In our study 3 patients in GROUP-F and 2 patient in GROUP-FM experienced nausea/ vomiting which was not significant statistically. There was no incidence of pruritis, urinary retention or other side effects in both the groups (**Table - 1**).

In a study conducted by Bilir, et al. [7] where Fentanyl PCEA in GROUP-F and Fentanyl PCEA with 50mg bolus Magnesium and continuous magnesium infusion epidurally in GROUP-FM, time to first analgesic requirement was slightly longer in GROUP-FM (51.6 min) compared to GROUP-F (37.1 min), Compared with patients in GROUP-F, there was 25% reduction in Fentanyl consumption at the end of 24 hr. Thus addition of Magnesium allowed lesser requirement of Fentanyl in postoperative period due to its NMDA receptor antagonism and potentiation of opioid action. This is comparable to results of the present study wherein adding Magnesium 50mg to epidural Fentanyl 50mcg markedly prolonged the duration of analgesia in GROUP-FM.

In a study conducted by R. Arcioni, et al. [8] using epidural infusion of Magnesium and Morphine for postoperative analgesia, postoperative Morphine requirements assessed for 36 hours was less in Epidural Magnesium group (24 mg) compared to control group (38.96 mg). Mean Morphine requirement was reduced by 38%. This was attributed to NMDA receptor antagonism of Magnesium and potentiation of good analgesia.

The duration of action of analgesia in group-F was 160 ± 18.19 (SD) min and in group-FM was

337.3+_{47.48} (SD) min in our present study. Statistically this is significant as 'p' value is <0.01.

There was increase in pulse rate in GROUP-F compared to GROUP-FM from 1 hour to 15 min could be attributed to onset of pain.

The mean arterial pressure between the two groups was comparable throughout the study period and they were stable. Oxygen saturation and respiratory rates remained stable and there was no significant difference between the groups. Thus it is concluded from our study that 50 mg Magnesium administered epidurally along with Fentanyl has no significant cardiovascular effects (**Table - 2**).

Bilir, et al. [7] in the study of Epidural Magnesium and Fentanyl for postoperative pain found that SBP, DBP, MAP, pulse rate and oxygen saturation remained stable with no significant difference between two groups. Epidural Magnesium had no adverse effects on cardiorespiratory systems.

In a study conducted by Arcioni, et al. [8] Epidural Magnesium reduces postoperative analgesic requirements, Magnesium maintained hemodynamic stability. There were no significant differences in hemodynamic and respiratory variables Pulserate, SBP, DBP, MAP, Oxygen saturation, respiratory rate. Thus we conclude from our study that epidurally administered Magnesium has no adverse effects on hemodynamics.

In our study, 50 mg of epidural Magnesium coadministered with Fentanyl in GROUP-FM resulted in lower VAS scores at 2, 3, 4 hours postoperatively and our observation coincided with study of Biliar, et al. [7] GROUP-FM patients had lower VAS scores ,excellent pain relief when compared to GROUP-F patients even after 6 hours.

Conclusion

Epidural Magnesium (50 mg) as an adjuvant to epidural Fentanyl (50 mcg) for postoperative analgesia resulted in prolonged duration of analgesia when compared to epidural Fentanyl (50 mcg) alone. Concomitant administration of epidural Magnesium also reduces the requirement for rescue analgesic with no increased incidence of side effects. Quality of analgesia in terms of patient satisfaction is also better with epidural Fentanyl plus Magnesium when compared to epidural Fentanyl alone.

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